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NOTES ON GEOGRAPHIC DISTRIBUTION

Insecta, Ephemeroptera: Transcontinental range extensions in western North America.

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Among the 631 valid species of Ephemeroptera (mayflies) that are presently known from North America (McCafferty 2007), relatively few have been known as having more or less continuous (non disjunct) transcontinental distribution patterns from the east coastal provinces of Canada and or east coastal states of the USA to the west coastal provinces of Canada or the west coastal states of the USA or Mexico. The best representation of such distribution patterns is in the family Baetidae, e.g., *Acentrella turbida* (McDunnough), *Baetis bundyae* Lehmkuhl (relatively sparse and northern), *B. flavistriga* McDunnough, *B. tricaudatus* Dodds, *Callibaetis ferrugineus* (Walsh), *C. fluctuans* (Walsh), *Diphetor hageni* (Eaton), *Paracloeodes minutus* (Daggy), *Procloeon bellum* (McDunnough) (relatively sparse and northern), and *P. pennulatum* (Eaton) (relatively sparse and northern). In other mayfly families such continuous transcontinental patterns are uncommon among species, or in the case of Caenidae, less common. They include such species as *Ameletus subnotatus* Eaton (northern) (Ameletidae); *Baetisca lacustris* McDunnough (Baetiscidae); *Caenis amica* Hagen, *C. latipennis* Banks, and *C. tardata* McDunnough (Caenidae); *Ephemerella aurivillii* (Bengtsson) and *E. excrucians* Walsh (Ephemerellidae); *Ephemera simulans* Walker and *Hexagenia limbata* (Serville) (Ephemeridae); *Heptagenia pulla* (Clemens) and *Maccaffertium terminatum* (Walsh) (Heptageniidae); *Tricorythodes minutus* Traver (eastern records possibly incorrect) (Leptohyphidae); *Leptophlebia cupida* (Say), *L. nebulosa* (Walker) and *Paraleptophlebia debilis* (Walker) (Leptophlebiidae); *Metretopus borealis* (Eaton) (relatively sparse and northern) (Metretopodidae); *Ephoron album* (Say) (Polymitarcyidae); and *Siphlonurus alternatus* (Say) (northern) (Siphlonuridae). In addition to these transcontinental species, there are a few others that are disjunct East and West species that are absent to a considerable extent in central regions of the continent.

Based on our recent studies of mayflies from the west coast states of California, Oregon, and Washington, and the western intermountain USA states (esp. Idaho), we are able to establish eight additional North American species with continuous transcontinental distribution patterns. In keeping with the trend among families shown above, six of these species are in the family Baetidae, and one is in the family Caenidae. We also demonstrate this distribution pattern in the family Pseudironidae for the first time. New western state records that substantiate the transcontinental patterns are given for each of the species treated below, followed by pertinent commentary regarding their distribution. Acronyms of the sources of materials appear in parentheses after collection data, and at the first appearance of such an acronym, the full name to which it refers is given. Records are based on the aquatic, larval life stage of the mayflies, unless specifically indicated as "adults" in the record data.

Baetidae

Acerpenna pygmaea (Hagen).
OREGON: Douglas County, Umpqua River, 30-VIII-2001 (EPA: United States Environmental Protection Agency, Corvallis, Oregon).
This species has historically been known as a relatively ubiquitous eastern and midwestern species, but recently has been reported extensively from the central plains, e.g., Saskatchewan (McCafferty and Randolph 1998) and Nebraska (McCafferty et al. 2001) and from the intermountain West, i.e., Alberta (Jacobus and McCafferty 2001), Colorado (McCafferty et al. 1993), and Idaho (Lester et al. 2002).

Baetis brunneicolor McDunnough.
IDAHO: Custer County, Grant Creek above Bartlett Road crossing, 14-VII-1998 (EA: EcoAnalysts, Moscow, Idaho); Owyhee County, Pleasant Valley, 10 m downstream of culvert, 14-VII-1998 (EA), and Owyhee County, Rock Creek (upper) following road to creek, 5-VIII-1998 (EA).

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WASHINGTON: Lewis County, Ohanapecosh River, 29-V-1997 (CSU: C. P. Gillette Museum, Colorado State University, Fort Collins, Colorado); Pierce County, White River, Route 410, Mount Ranier National Park, 29-V-1997 (CSU).
Previously this species was known as an eastern and upper midwestern species extending westward to far western South Dakota (McCafferty 1990). As workers are becoming adept at morphologically differentiating larvae of this species from *B. tricaudatus* Dodds in the East (see Morihara and McCafferty 1979), it is proving to be common in that part of North America. Larvae of *B. brunneicolor* are easily differentiated from *B. tricaudatus* in the West based on larval pronotal color pattern (in addition to morphology), and thus, based on the scant number of *B. brunneicolor* material in the West, we conclude that it is considerably less common in the western half of the continent.

Callibaetis pallidus Banks.
CALIFORNIA: Alameda County, Tilden Park, 13-V-1952 (UCB: Essig Museum of Entomology, University of California, Berkeley, California); Nevada County, Sagehen Creek, 20-VII-1978, adults (UCD: Bohart Museum, University of California, Davis, California); San Diego County, Julian, 4-VII-1962, adults (UCD).
This species was known previously from northeastern USA and eastern Canada, through Michigan and central Canada to as far west as Alberta (Neave 1929), Utah (Needham and Christenson 1927), and Arizona (Lugo-Ortiz and McCafferty 1995). Although widespread, *C. pallidus* does not appear as ubiquitous as some other North American species of *Callibaetis* Eaton.

Heterocloeon anoka (Daggy).
OREGON: Deschutes County, Deschutes River, 14-IX-2000 (EPA); Grant County, Middle Fork John Day River, 16-VII-2001 (EPA).
WASHINGTON: Benton County, Amon Wasteway, Lower Amon, 1-IX-2000 (PERC: Purdue Entomological Research Collection, Purdue University, West Lafayette, Indiana); Spokane County, Little Spokane River, Milan, 25-VII-1962, adults (PERC).
The previous farthest west records of this species were Alberta (Webb and McCafferty 2003), and Idaho, given as the junior synonym *Pseudocloeon edmundsi* Jensen, by Jensen (1969) (see McCafferty 2006). Because the latter record was taken on the Snake River where it forms the border with Oregon, it is applicable to Oregon as well. It should be noted that historically *H. anoka* has been commonly misidentified as *Plauditus punctiventris* (McDunnough), and it appears that any previous far western records attributed to *P. punctiventris* are applicable to *H. anoka* (see McCafferty et al. 2005; McCafferty 2006). Based on our recent study of the original morphotype material held at the Royal Ontario Museum, we are here able to confirm that the larval description of *P. punctiventris* by Ide (1937) was incorrectly based on larvae of *H. anoka*.

Pseudocloeon dardanum (McDunnough).
IDAHO: Canyon County, Boise River, at Caldwell, 22-IX-1963 (PERC); Canyon County, Nampa, 23-VIII-1947, adults (PERC).
WASHINGTON: Jefferson County, Taft Creek, west of Hoh River Rain Forest Visitor's Center, Olympic National Park, 20-VI-1978 (PERC).
This species was historically known mainly from Ohio to Colorado (Durfee and Kondratieff 1994) in the U.S.A., and from Quebec to Alberta (Soluk 1981) in Canada. Its range was recently extended to the east coast in the U.S.A., and it was predicted to be more common in the East than previous data suggested (McCafferty et al. 2004).

Pseudocloeon propinquum (Walsh).
CALIFORNIA: Riverside County, Deep Canyon, 10-VII-1963, adults (PERC); Shasta County, Hat Creek, Big Springs, 10-X-1976 (INHS: Illinois Natural History Survey, Champaign, Illinois); Shasta County, Hat Creek, Highway 299, 8-X-1976 (INHS).
OREGON: Benton County, Long Tom Canal, 21 kilometers south of Corvallis, 21-V-1975 (OSU: Oregon State Arthropod Collection, Oregon State University, Corvallis, Oregon); Douglas County, Wind Creek, 16-VIII-2001 (EPA); Klamath County, Sprague River, 10-VI-1975 (OSU); Lake County, Coyote Creek, 5-VI-1999, (PERC).
WASHINGTON: King County, Big Soos Creek, Auburn, 24-VIII-1998 (USGS: National Water Quality Laboratory, United States Geological Survey, Denver, Colorado); Lewis County, Centralia, 26-VII-1936, adults (INHS).

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This species has been known as far west as the Yukon in Canada (Wiens et al. 1975) and Idaho in the USA (Newell and Minshall 1978), and otherwise it is fairly well represented in the intermountain West, central plains, and eastern North America.

Caenidae

Caenis punctata McDunnough.
CALIFORNIA: Riverside County, Santa Margarita River, Highway 395, 28-VIII-1969 (UCR: Entomology Research Museum, University of California, Riverside, California).
This species is common in the eastern half of North America, and in the southern half of the continent it has been known to extend westward to Colorado (McCafferty et al. 1993). Based on previous records, the discovery of *C. punctata* in California may not have been predictable, and should be regarded as relatively uncommon in western North America.

Pseudironidae

Pseudiron centralis McDunnough.
CALIFORNIA: Sacramento County, Sherwood Harbor, Sacramento River, west of Sacramento, 14-V-2003 (PERC); Yolo County, Sacramento River, west of Sacramento, 14-V-2003 (PERC).
This species develops on sandy bottom streams throughout eastern and central North America, and has been known as far west as Alberta (Pescador 1985) and Utah (Edmunds and Musser 1960). The Edmunds and Musser (1960) report was for *Pseudiron* sp., but we have seen the material and verified that it is referable to *P. centralis*. The shifting sand substrate of the Sacramento River provides the necessary habitat for the specialized predatory larvae of this species (McCafferty and Provonsha 1986; Soluk and Craig 1990; McCafferty 1991), and we deduce that at one time it may have occurred everywhere such habitats were available in North America.

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Literature cited

Durfee, R. S. and B. C. Kondratieff. 1994. New additions to the inventory of the Colorado mayflies (Ephemeroptera). Entomological News 105: 222-227.

Edmunds, G. F. and G. G. Musser. 1960. The mayfly fauna of Green River in the Flaming Gorge Reservoir Basin, Wyoming and Utah. University of Utah Anthropological Papers 48: 111-123.

Ide, F. P. 1937. Descriptions of eastern North American species of baetine mayflies with particular reference to the nymphal stages. Canadian Entomologist 69: 219-231, 235-243.

Jacobus, L. M. and W. P. McCafferty. 2001. Additions to the Canadian Ephemeroptera. Journal of the New York Entomological Society 109: 367-371.

Jensen, S. L. 1969. A new species of *Pseudocloeon* from Idaho (Ephemeroptera: Baetidae). The Pan-Pacific Entomologist 45: 14-15.

Lester, G. T., W. P. McCafferty, and M. R. Edmondson. 2002. New mayfly (Ephemeroptera) records from Idaho. Entomological News 113: 131-136.

Lugo-Ortiz, C. R. and W. P. McCafferty. 1995. An annotated inventory of the mayflies (Ephemeroptera) of Arizona. Entomological News 106: 131-140.

McCafferty. W. P. 1990. Biogeographic affinities of the Ephemeroptera of the Black Hills, South Dakota. Entomological News 101: 193-199.

McCafferty, W. P. 1991. Comparison of Old and New World *Acanthametropus* (Ephemeroptera: Acanthametropodidae) and other psammophilous mayflies. Entomological News 102: 205-214.

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McCafferty, W. P. 2006. New synonym and western range extension for *Heterocloeon anoka* (Daggy) (Ephemeroptera: Baetidae). Proceedings of the Entomological Society of Washington 108: 738.

McCafferty, W. P. 2007. Mayfly Central: Mayflies of North America. Electronic database accessible at http://www.entm.purdue.edu/entomology/research/mayfly/mayfly.html. Purdue University, West Lafayette, Indiana, USA. Captured on 9 January 2007.

McCafferty, W. P. and A. V. Provonsha. 1986. Comparative mouthpart morphology and evolution of the carnivorous Heptageniidae (Ephemeroptera). Aquatic Insects 8: 83-89.

McCafferty, W. P. and R. P. Randolph. 1998. Canada mayflies: a faunistic compendium. Proceedings of the Entomological Society of Ontario 129: 47-97.

McCafferty, W. P., R. S. Durfee, and B. C. Kondratieff. 1993. Colorado mayflies (Ephemeroptera): an annotated inventory. Southwestern Naturalist 38: 252-274.

McCafferty, W. P., T. H, Klubertanz, R. P. Randolph, A. V. Provonsha, H. R. Lawson, and B. C. Kondratieff. 2001. Mayflies (Ephemeroptera) of the Great Plains. I. Nebraska. Transactions of the American Entomological Society 127: 5-29.

McCafferty, W. P., M. D. Meyer, J. M. Webb, and L. M. Jacobus. 2004. New state and provincial records for North American small minnow mayflies (Ephemeroptera: Baetidae). Entomological News 115: 93-100.

McCafferty, W. P., R. D. Waltz, J. M. Webb, and L. M. Jacobus. 2005. Revision of *Heterocloeon* McDunnough (Ephemeroptera: Baetidae). Journal of Insect Science 5(35): 1-11.

Morihara, D. K. and W. P. McCafferty. 1979. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105: 139-221.

Neave, F. 1929. Reports of the Jasper Park Lakes Investigation, 1925-26. IV. Aquatic insects. Contributions to Canadian Biology and Fisheries 4: 187-195.

Needham, J. G. and R. O. Christenson. 1927. Economic insects in some streams of northern Utah. Bulletin of the Utah Agricultural Experiment Station 201: 1-34.

Newell, R. L. and G. W. Minshall. 1978. An annotated list of the aquatic insects of southeastern Idaho, part III. Ephemeroptera. The Great Basin Naturalist 38: 55-58.

Pescador, M. L. 1985. Systematics of the Nearctic genus *Pseudiron* (Ephemeroptera: Heptageniidae: Pseudironinae). The Florida Entomologist 68: 432-444.

Soluk, D. A. 1981. The larva of *Baetis dardanus* McDunnough (Ephemeroptera: Baetidae). Entomological News 92: 147-151.

Soluk, D. A. and D. A. Craig. 1990. Digging with a vortex: flow manipulation facilitates prey capture by a predatory stream mayfly. Limnology and Oceanography 35: 1201-1206.

Webb, J. M. and W. P. McCafferty. 2003. New records of mayflies (Ephemeroptera) from Alberta, Canada. Entomological News 114: 230-232.

Wiens, A. P., D. M. Rosenberg, and N. B. Snow. 1975. Species list of aquatic plants and animals collected from the Mackenzie and Porcupine River watersheds from 1971-1973. Canadian Fisheries and Marine Service Technical Report 557: 1-39.

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